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THE HYDRO-ELECTRIC PLANT AT D'AVIGNONNET SUR LE DRAC.

The Societe Franco-Suisse Pour L'Industrie Electrique of Geneva, Switzerland, owns and operates the Usine Hydro-Electrique D'Avignonnet, which is supplied with water from an artificial lake or reservoir having a capacity of 1,500,000 cubic meters of water; the dam built for retaining this vast amount of water being noted in Fig. 1. The Drac River rises in the Champeaur Mountains in the Alps and provides sufficient water for 8000 horse-power at this plant at high water, about half of this being available at low water periods.

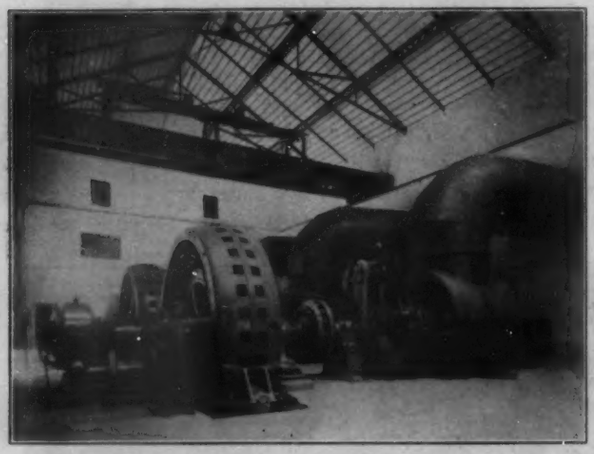
DRAC RIVER DAM FOR HYDRO-ELECTRIC PLANT

The power house was designed to contain seven turbines of 1750 horse-power each, the present output being 5500 horse-power for twelve hours daily. The station is constructed of stone, brick and steel, and has a tile roof with an overhead electrically operated traveling crane for handling the heavy parts of alternators and turbines during erection and for repairs. The turbines were installed by Piccard, Pictet & Cie of Geneva, Switzerland, and the alternators were built at Creusot, France, by the engineering firm of Schneider & Cie. The revolving field high tension alternators are driven at a speed of 250 revolutions per minute and have their fields excited by multipolar direct current dynamos mounted on the same shafts as the turbines and large generators outside of the main bearing, a flexible coupling being used for the direct connection of

the turbine and alternator, in each unit.

The water is conducted 840 meters to the turbines, giving a net effective head of 23.31 meters, each turbine of 1750 horse-power capacity operating at a speed of 250 revolutions per minute. These Swiss turbines are of the double discharge type, the water entering the top by penstocks having a right angle bend just above the turbines, the penstocks entering the power-house through the right hand wall as noted in the interior view, and discharging through a common tailrace concrete pipe.

The speed is governed by the "Regulateur Servomoteur" shown on the top of the turbines and belted to the



1750 H. P. TURBINES AND ALTERNATORS AT ISERE, FRANCE

main shafting, and it is stated that the regulation is very satisfactory even with the greatest changes in load on the power transmission line.

The diameter of the opening at the top of the turbine connecting with the penstock is 2.2 meters and the rotor is 1380 millimeters in diameter, while the distance between centers of the discharge pipes is four and one-half meters. From the center of the turbine and alternator shaft to the floor line measures 1.2 meters and the total length of the turbine without the alternator coupling is about eight meters, while its total height is about three meters. The efficiency of these turbines is said to be very high and the entire electrical installation has been working satisfactorily.

Coalite, a new fuel recently brought out in England, is the product of the partial distillation of coal, being a black and friable residue, composed in large part of volatile matter. This residue is compacted into a hard substance like coke, the process, however, being a secret one. Tests have shown that, although coalite contains a smaller number of heat units per pound than soft coal, nevertheless a much larger percentage of its heating value can be utilized, one ton of coalite being equal in heating value to one and one-half tons of bituminous coal. Its adoption as a fuel will depend largely on the price at which it can be sold, this, in turn, depending on the prices which can be realized for the by-products of distillation—gas and ta:

INCANDESCENT LIGHTS.

One of the largest specialized departments of electrical production is that of incandescent lighting. The gain in this branch since the year 1900 has been quite remarkable, the total value rising from $3,515,118 to $6,953,205, as shown in the report of the Census Bureau for 1907, so that the amount has almost doubled in the period. The principal gain as to quantity and value has notably been in sixteen candle-power lamps, which remain the standard, although there are indications that it is likely to be raised, owing to the competition of gas of higher candle-power than was common when the incandescent lamp was introduced. The number of incandescent lamps of sixteen candle-power has risen from 21,191,131 to 83,333,285, and the value has nearly doubled, but it will be seen from the table that there has been a remarkable reduction in value per lamp, so that these lamps reach the consumer at a retail price proportionately reduced. Lamps below sixteen candle-power in illuminating capacity are used to an increasing extent for various purposes, and the number increased from 2,906,817 to 19,779,834, or more than fivefold. The value rose from $308,626 to $1,132,011. In like manner there was a remarkable increase in the number and value of the lamps above sixteen candle-power, these being principally thirty-two and fifty candle-power. The number increased from 1,222,250 to 9,598,439, the gain being almost sevenfold. The increase in decorative and miniature lamps, etc., is not so great as might have been expected from the prevalence of street signs, but the increase was from 397,432 to 1,584,495, with a correspondingly large increase in the value. As a matter of fact, a large proportion of lamps below sixteen candle-power are employed for decorative and sign purposes. It is only in the group of decorative and miniature lamps that an increase in price per unit is shown, but this is due to the attempts to place at the disposal of the public very small lamps of ingenious design and construction for special effects. In reality, the product throughout the group as a whole shows a remarkable reduction in cost, the more noteworthy in view of the fact that during the past five years nearly fifty manufacturers have allied themselves under the protection of certain patents, standardizing their methods of production and quality of output. This combination does not constitute a monopoly, as there are also a large number of independent manufacturers.

The importance of the incandescent lamp in the field of electrical industry is evidenced by the fact that, as shown by the statistics of the Bureau of the Census in the Report on Central Electric Light and Power Stations, out of a total of 3,620 private and municipal stations enumerated in 1902, no fewer than 3,484 were engaged in commercial or other private incandescent lighting, while 606 private and municipal plants reported that they were engaged exclusively in the business of incandescent lighting. Further evidence as to the importance of the incandescent lamp was given by the fact that of the total income of all stations of $85,700,605 more than half—$44,657,102—was derived from incandescent service.

Before noticing the more radical innovations in the art of incandescent lamp manufacture it is well to put on record the improvements which have come from the perfection of familiar processes, and have gradually reduced the

selling price of the lamp of the carbon filament type to a point where practically ten lamps are sold for a dollar instead of one. The carbon filament lamp, when introduced, contained about thirty times as much platinum in the leading-in wires to which the carbon strip is attached as does the lamp of the present day. The exhausting of air from the lamp by mercury pumps in order to create a high vacuum now requires but a single minute, where half an hour was necessary ten years ago, and from four to five hours at the beginning of the art. As a matter of fact, twenty-five years ago the mere cost of exhausting a lamp was greater than the whole cost of the lamp at the present time. All the glass blowing operations on the bulb have been changed from hand work with expensive skilled labor to machine work that a tyro can regulate, and the labor cost of the glass processes is barely ten per cent of what it was in 1882. All the lamps sent out are tested by photometric process, but to-day that incidental work costs but one-tenth of what it did formerly. The first successful lamps were based upon carbon filaments made from paper and bamboo, but at a very early stage cellulose material was employed, and it has now come into universal use. Such lamps, of a standard sixteen candle-power capacity, require but fifty watts of electrical power for their full efficiency, so that the current consumption has also been cut in two. It is estimated that in the first quarter of a century 250,000,000 incandescent lamps of carbon filament type were produced, or at the average rate of 10,000,000 a year; but, as the figures already quoted indicate, the total number is now over 100,000,000 a year.

It is probable that for some time to come lamps of the carbon filament type will continue to be manufactured in large quantities, but even in these, important improvements have recently been made, the object being to secure high candle-power with less consumption of current. The principal lamp of this modified character has what is known as the "metallized" carbon filament, which is rated at 2.5 watts per candle-power, as compared with the plain carbon filament type, whose standard consumption has been 3.10 watts per candle-power. The new filament is obtained by applying an additional process to the ordinary carbon filament, the treatment including heating in an electric furnace to a temperature of from 3,000 to 3,700 degress Centigrade, this firing being performed both before and after treatment. The additional processes result in the production of an exceedingly pure form of carbon, having greater density and considerably less specific resistance than the older filament, while the temperature coefficient is changed from negative to positive. For this latter reason the term "metallized" has been employed to describe the new filament, although it contains no metal. These lamps are now generally available in all the standard sizes and have immediately become popular.

A far more important and radical advance is that which has been made in the production of incandescent lamps with metallic filaments in place of carbon. Some of the very earliest work in the subdivision of electrical current for lighting purposes was done with filaments of a metallic character, such as platinum, but these were found at the time insufficient to serve as the basis of a commercial art, although hope in that direction was not entirely abandoned. Experiment has been maintained for many years, and the first success is due, as in so many other fields of chemical and metallurgical research, to the perseverance of German scientists. Several years ago, with the fundamental principle as a starting point, that the visible part of radiation from an incandescent lamp filament increases progressively with the temperature of the filament, elaborate laboratory experiments were begun in Germany to discover a metal that would withstand a much higher temperature than the carbon lamp filament can endure economically. The result of a long series of tests was to determine the selection of tantalum, which in a pure state was found to yield very satisfactory results.

The chemical properties of tantalum are very remarkable. When cold, the material strongly resists chemical agents; it is not attacked by boiling hydrochloric acid, nitric acid, or sulphuric acid, and it is also indifferent to alkaline solutions; it is attacked solely by hydrofluoric acid. Heated in the air, it assumes a yellow tint at about 400 degress Centigrade like steel, and also like steel the tint changes to dark blue when the tantalum is exposed for some time to 500 degress Centigrade. Thin wires of it when ignited burn with low intensity and without any noticeable flame. It greedily absorbs hydrogen as well as nitrogen, even at a low red heat, forming with them combinations of a metallic appearance, but rather brittle. It combines with carbon very easily, forming several carbides which, as far as they are at present known, are all of metallic appearance, but very hard and brittle. When in the form of powder, still containing, as previously stated, oxide and hydrogen, the specific gravity is about fourteen; when purified by fusion and drawn into wire, it has a specific gravity of 16.8. It is somewhat darker than platinum and is about as hard as mild steel, but shows greater tensile strength. It is malleable, although the effect of hammering is relatively small, so that the operation must be long and severe to extend the metal into a sheet. It can be rolled as well as drawn into very fine wire. Its tensile strength as a wire is remarkably high and amounts to 133,000 pounds per square inch. The electrical resistance of the material at indoor temperature is 0.165 ohm for a length of one meter and a section of one square millimeter; the temperature coefficient is positive and has a value of 0.30 between 0 and 100 degrees Centigrade. At the temperature assumed by the incandescent filament in the lamp under a load of 1.5 watts per candle-power, the resistance rises to 0.830 ohm for a length of one meter and a section of one square millimeter. The Siemens-Halske Company in Germany has taken out about 200 patents on the tantalum lamp, comprising about 1,000 claims. Experiments with many hundreds of the tantalum lamps gave a useful life of 400 to 600 hours, during which it consumed about 1.5 watts per candle-power. Useful life is defined as the time at the end of which the lamp has lost twenty per cent of its "light power." The candle-power increases during the first 100 hours, whereby the specific power consumption decreases to about 1.3 watts per candle. The latter then increases, and at the end of the useful life the lamp consumes 1.8 to two watts per candle. The lamp, however, continues to burn for 1,000 or 1,500 hours. It is found to burn much better on direct than on alternating current, as the latter appears to disintegrate the filament rapidly; and in the United States it is now being used only on direct current circuits. The price to the retail purchaser of a twenty-two candle-power tantalum lamp, consuming forty-four watts of electrical power, is sixty cents; and the New York Edison Company, which supplies new lamps free to its customers, makes a charge of thirty-five cents for this lamp. This practice may be taken as an index of the general practice of the central station companies in introducing the new illuminant. The makers in Germany have produced and placed on the market a 2.2 watt lamp for pressures of 50, 55, 60, 65, 75, 100, and 110 volts, whose useful life is quoted as being from 800 to 1000 hours, with the total life often reaching 1500 or 2000 hours.

Another lamp of the metallic filament type is the osmium, which has been introduced to some extent in

Europe but is not yet widely known in the United States. The crude material is very finely divided osmium—one of the rare metals—which is mixed with binding substances so as to form a thick, tough paste, which is forced under very high pressure through a die. A thread is thus obtained, which is formed into loops. The threads are then dried and heated in a vacuum in order to carbonize the binding material, and they are next subjected to the processes of formation. The threads, which at this stage consist of porous, rough osmium with a high content of carbon, are heated for a long time by means of electric current, being brought gradually through higher and higher temperatures to white heat in an atmosphere containing a great deal of steam and various quantities of reduced gases. In this manner the filament becomes pure porous osmium of a far greater density than the original rough thread. During the use of the lamp the osmium surface becomes gradually smoother and smoother, which accounts for the increase in the light given out by the lamp in the first few hours of use. The filament, which has an approximate length of fifteen inches, is divided into three separate loops connected in series by means of two loops of platinum wire, the middle of each of which is fused, by means of a glass bead, to the top of the stem carrying the two leading-in wires. Each filament is anchored in order to prevent the loops from touching the dome of the bulb, and the anchor device consists of a small glass rod to the end of which is attached a turn of small wire or white refractory metal. The filament is anchored not at its extremity but somewhat above the turn of the loop. The lamps can be burned only in a vertical downward position. The consumption is 1.5 watts per candle-power, and the standard type is a fifty-volt twenty-five candle-power lamp, guaranteed at that consumption of electrical power. The useful life of the lamp is given as about 2,000 hours, but some have been burned 5,000 hours. The osmium lamp is somewhat more fragile than the ordinary carbon filament lamp if exposed to hard knocks, but it seems able to withstand a great deal of vibration, as in train lighting, for which it has proved satisfactory in connection with storage battery equipments. Its low voltage has also made it desirable for mine safety lamp purposes.

Another lamp of this character is one in which the filament is made from a metal alloy of which the rare metal zirconium is a component. Lamps of this kind require only a small pressure, such as two or four volts, and hence, like the osmium, are available more particularly in connection with storage batteries. Tests on these lamps show that two candle-power lamps at four volts give a consumption of 0.92 watt per candle-power, whereas the ordinary carbon filament lamp of the same low candle-power consumes 3.8 watts. The lamp is expensive in first cost, but, as will be seen, the cost of operation is low, and a more recent lamp of this type is reported to have a consumption of 1.2 watts per candle-power with a life of 500 hours, but needs careful handling and is commercial only on low voltages.

The latest development in metallic filaments for incandescent lamps relates to the work on tungsten, conducted principally abroad, although in the last three or four years a large amount of research and investigation has gone on in the United States also. The merit of the tungsten lamp consists in the fact that it consumes only between 1 and 1.25 watts of electrical power per candle-power, as compared with the 3.10 of the ordinary carbon filament type, 2.5 of metallized filament, and the 2 watts of the tantalum lamp. While tungsten is considered one of the rare elements, its compounds are already of considerable use. Sodium tungstate is employed in impregnating fibres to make them fireproof, and as a mordant in dyeing. Tungsten bronzes are employed largely as bronze powders and pigments. The chief employment of tungsten in recent years, however, has been for high-speed tool steels and for ordinary steel in armor plates and large guns. A few years ago very little was produced in this country, but the quantity of tungsten concentrates reported for the year 1905 was 803 tons. The tungsten concentrates valued formerly at $2 or $3 per unit are now worth at least $6 per unit, the unit meaning one per cent of a ton. It will be obvious, therefore, that tungsten is a rare element, although not in the same sense as osmium or platinum. Like most metals proposed for incandescent lamp filaments, tungsten has a lower electric resistivity than carbon, and for this reason the manufacture of high voltage tungsten lamps is a more difficult process than is the production of carbon lamps for the same voltages—say, the standard, 110. In the main, however, these difficulties in the manufacture of tungsten lamps have been successfully overcome, as the lamps are now on the market in both Europe and the United States.

The fundamental value of tungsten for lamp filaments lies essentially in its enormously high point of melting or volatilization. In this respect it perhaps resembles carbon and the nonmetallic elements. In the common use of the word "metal," pure tungsten is virtually unknown. It has not yet, for instance, been reduced to ingot form from which anything could be hammered, or cut, or drawn. Hence, so far as is known, a filament of wire such as is used in the tantalum lamp, for example, can not be paralleled or duplicated from tungsten, so that the filaments now in use in tungsten lamps have to be obtained by what may be called roundabout methods, and when completed are like carbon filaments, aggregations of amorphous structures or of infinitesimal crystals. Three different processes are in use for making tungsten filaments.

The first process is based on the effort to coat a carbon filament with tungsten and results in the simultaneous dissolution of the carbon filament, and its replacement by finely divided tungsten, which is strengthened by a process akin to "flashing," or, in other words, the heating up of the filament in the vapor of a tungsten compound. The other two processes start with very finely divided tungsten, worked up into a paste, from which the filaments are formed. Further treatment is then given by firing. The earlier processes dealt with a paste made of what may be called precipitated tungsten. The later process is based on so-called colloidal metal, which presents the advantage of almost infinitely fine subdivisions. The result is of the same nature, whether the filament is prepared by the "substitution" process, the paste process, or the colloidal process—namely, an extremely fine thread one or two mils in diameter, of compactly aggregated pure or nearly pure tungsten. These filaments are dense and of smooth and uniform appearance, but thus far appear to be quite brittle, as might be anticipated from their structure. The elimination of this tenderness is one of the problems of the future for this new lamp. These lamps have an advantage over the tantalum in the fact that they can be burned equally well on both alternating and direct current; but like the tantalum, the tungsten lamp is best burned in a vertical downward position, although in this respect it more nearly resembles the osmium. The lamps that have been introduced commercially are rated at twenty-five candle-power, consuming one watt per candle-power and are given a life of not less than 1,500 hours. A standard lamp introduced in Europe and already known in the United States consumes forty watts and has three filament loops with a total length of filament of seventeen inches.

THE FUTURE OF GAS LIGHTING.

The vocation of prophet has always been beset with numerous pitfalls, especially "in his own country." Nevertheless, prophecies still continue to be made, for the reason that they are always exceedingly interesting to the prophet, and occasionally contain some germs of thought that are worthy of cultivation. The occasion of the meeting of the Gas Institute, following the hundredth anniversary of the introduction of gas as a commercial luminant, naturally inspires the inquiry, What will the next hundred years develop in gas lighting?

The introduction of illuminating gas marked the definite close of the dark ages, literally speaking. Previous to this period there was no public lighting which could justly be called illumination. The progress that has been made within the century in the production and use of artificial light is a fair measure of the general progress in science and art during the same period,—a progress that has been so rapid that it has created a new heaven and a new earth. Amidst all the wonders of modern life it is doubtful if any single one would more profoundly impress our ancestors of a hundred years ago, could they assume their physical bodies again, than our present lavish use of light, both public and private. To say that the next hundred years will witness as great an improvement in this respect, is an easy and perhaps safe, prophecy; but to conceive what illumination will be when developed to such an extent would tax the most fertile imagination.

But to leave this purely speculative view and return to matters that more closely affect us: What is to be the position of gas illumination in the near future?

Unquestionably gas lighting is being driven to the wall, in this country, by the electric light. The reason for this must be sought in the conditions which at present govern the financial world, rather than in the relative merits of gas and electric illumination. As a luminant gas more than holds its own in Great Britain and France, and is fully holding its own in other parts of Europe; and this cannot be attributed to any lack of appreciation of good illumination on the part of Europeans. The simple fact is, that in this country we have fulfilled almost to the limit the truth so admirably expressed by the great English engineer Stevenson, that "where combination is possible competition is impossible." Certainly nothing is more possible than the combination of gas and electric interests; and where this combination has taken place economic conditions favor the largest possible use of electric current for lighting, with a corresponding diminution in the use of gas lighting. The average American is too busy to argue and investigate minor matters, and in such cases takes what is offered him, especially if it has the advantage of requiring less personal care and attention; and with the advantage of convenience, which the electric light undeniably possesses, skilfully presented, and the advantage of cheapness possessed by gas passed over in silence, the acceptance of the newer luminant is a foregone conclusion. The advantage of cheapness, however, is one that cannot be wholly damned, even by the faintest praise; and notwithstanding the recent remarkable improvements in efficiency in electric lamps, this advantage with gas seems likely to continue, even if in a somewhat less marked degree.

By relying solely on the advantage of cheapness, gas has been forced into the position of a second-class luminant, and this fact in itself is the most serious obstacle to its future progress.

To brand a commodity as "cheap" is to "queer" it in the eyes of the average American. As a matter of fact, there is scarcely a single case of electric lighting, in which equally good results, so far as illumination goes, could not be produced by gas, and in most cases at far less cost; but to light with gas is to use a "cheap" luminant, and the American will have none of it. For this condition of affairs those responsible for the management of the gas industries are to a considerable extent to blame. They have rested complacently on their oars, relying on the very great advantage in price to carry them along; while the electric interests have set full sail to catch the winds of popular fancy for more pleasing effects, and have thereby left their brethren of the gasometer as hopelessly marooned as the "Ancient Mariner." To such an extent has electric lighting surpassed gas lighting in this particular that it is doubtful if the latter can ever overcome the handicap.

It would be interesting and highly instructive to see what could be done toward rehabitating gas as a first-class luminant by the application of the same quality of energy, progressiveness, originality and perseverance in presenting its possibilities to the public, that is displayed by the majority of central stations. There are still a considerable number of towns in which gas and electric interests are independent, and each of these offers an opportunity for such a trial, and incidentally for the successful leader to gain national distinction in the illuminating industry. Unless such an effort is made more or less generally, there seems to be no other prospect for gas lighting than to gradually lose ground until it becomes a mere relic, like the candle of the present time.

The manufacturers of gas burners and accessories are not in the least to blame for this decadence in the use of gas lighting. The incandescent electric lamp, which has been the back-bone of the electric lighting industry, and the Welsbach gas burner, were introduced simultaneously; and in the twenty-five years since their introduction, the improvements in gas burners and mantles have at least kept pace with the improvements that were made in the electric lamp.

The fact that an entirely new luminant, the very principles of which were a mystery, even to those most familiar with it; the means of producing which had to be developed from the most rudimentary principles; which was from two to five times as expensive as gas; and which had vested interests of millions of dollars, with an organization that had been established for fifty years, to combat, has within twenty-five years established for itself an unquestionable supremacy in the lighting industry, is a remarkable phenomenon, and one which is worthy of close study.

The truth of the matter is, that the gas interests were over-confident; and while they were belittling the electric light in a spirit of self-complacency, the electrical interests looked into the future, foresaw its possibilities, and while the enemy was asleep executed a flank movement which soon put them in the lead. Unless better generalship is shown by the gas interests, so far as lighting is concerned, they are destined to dwindle into a mere horde of camp followers, picking up such discarded bits of lighting as the electrical interests may see fit to leave in their trail. There is not, to our knowledge, a single independent gas company at the present time employing an illuminating engineer, or that seems to have grasped the fact that illuminating engineering is a force to be reckoned with. The electrical interests, on the other hand, were alert to the importance of placing this new science on a sound footing from the very beginning, and are thus preparing to reap the full fruits of their first victories.—The Illuminating Engineer.

Approved Electrical Devices

This department from time to time will contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

CONDUIT BOXES, FLOOR OUTLET.

Kliegl. Waterproof floor outlet box. Cat. No. 300. Approved October 31, 1907. Manufactured by the

Universal Electric Stage Lighting Co., New York.

CUTOUT BASES, CARTRIDGE FUSE.

Peru. Main and branch blocks, 0-100 amperes, 250 and 600 volts. Approved October 31, 1907. Manufactured by

Peru Electric Mfg. Co., Peru, Ind.

CUTOUT BASES, EDISON PLUG.

Freeman, 2 to 2-wire and 3 to 2-wire, main line, single and double branch blocks. Approved October 30, 1907. Manufactured by the

E. H. Freeman Electric Co., Trenton, N. J.

HEATERS, ELECTRIC.

"American." Portable types, disc stove, domestic style. Cat. Nos. 3220, 3230 and 3235. Water Heater, Cat. No. 5215, Coffee Percolator, Cat. No. 5315. Tea Kettles, Cat. Nos. 5415 and 5420. Chafing Dishes, Cat. Nos. 335, 345, 337 and 347. Curling Iron Heaters, Cat. Nos. 117, 111, 113, 115, 150, 112 and 116. Glue Pots, Cat. Nos. 141 and 143. For voltages up to 250. Equipped with approved heater cord and detaching plugs. Approved October 31, 1907. Manufactured by the

American Electrical Heater Co., Detroit, Mich.

INSULATING SUPPORTS.

"Paiste" Cross-over Insulator. Cat. No. 4212. A small one-piece porcelain device having opposed projecting pairs of lugs, designed to be used instead of tubes where wires are run crossing at right angles with each other. Approved October 31, 1907. Manufactured by

H. T. Paiste Co., Philadelphia, Pa.

RECEPTACLE FOR ATTACHMENT PLUGS.

Kliegl. Flush stage receptacle No. 216, cast-iron casing with slate receptacle, 50 amperes, 125 volts. Red fiber plug No. 301, with clamp for removing strain of cable on terminals, 50 amperes, 125 volts. Approved October 31, 1907. Manufactured by the

Universal Electric Stage Lighting Co., New York.
Kliegl Bros., Props.

SOCKETS, STANDARD.

Paiste, brass shell, key and keyless. Cat. Nos. 9386, 9392, 50,760, 50,768, 19,386, 19,392, 49,386, 49,392, 99,386, 99,392; and "Security Snap," Cat. Nos. 44,147, 44,152, and 44,814, 44,815. Also above types with shade holders attached. Approved October 31, 1907. Manufactured by

H. T. Paiste Co., Philadelphia, Pa.

CABLES, ARMORED.

"Flexsteel." Flexible armored cable, single wire or multiple conductors. Approved October 22, 1907. Manufactured by the

National Metal Molding Co., Pittsburg, Pa.

Greenfield. Approved October 22, 1907. Manufactured by

Sprague Electric Co., New York.

Sterling. Approved October 22, 1907. Manufactured by

The Sterling Conduit Co., Pittsburg, Pa.

CONDUIT, UNLINED.

"Flexsteel." Flexible steel conduit. Approved October 22, 1907. Manufactured by

National Metal Molding Co., Pittsburg, Pa.

Greenfield flexible steel conduit. Approved October 22, 1907. Manufactured by the

Sprague Electric Co., New York.

Sterling flexible steel conduit. Approved October 22, 1907. Manufactured by

The Sterling Conduit Co., Pittsburg, Pa.

FLEXIBLE CORD, PORTABLE.

"Flexsteel" armored flexible cord. Approved October 22, 1907. Manufactured by the

National Metal Molding Co., Pittsburg, Pa.

Greenfield armored flexible cord. Approved October 22, 1907. Manufactured by the

Sprague Electric Co., New York.

FLEXIBLE CORD, PORTABLE, FOR ELECTRIC HEATERS.

Double conductor cord composed of braided conductors with rubber and asbestos coverings, protected by outer braid. Approved October 22, 1907. Manufactured by

Alfred F. Moore, Philadelphia, Pa.

LAMP ADJUSTER.

Eclipse mechanical system, consisting of a small rope passing over a fixed and movable pulley and arranged to support an incandescent lamp. For use only with reinforced portable cord, and when so arranged that such portable cord does not pass over the pulleys. Approved September 19, 1907. Manufactured by

J. W. Carter, Abilene, Texas.

MOULDING.

"National" Metal Moulding with metal fittings. Approved September 10, 1907. Manufactured by

The National Metal Moulding Co., Pittsburg, Pa.

RECEPTACLES, STANDARD.

G. E. Cat. No. 46,627. Porcelain flush receptacle for metal signs, 3-A., 250-V. Approved September 18, 1907. Manufactured by

General Electric Co., Schenectady, N. Y.

SWITCHES, AUTOMATIC.

"Perfect" Time Swith. Cast-iron case enclosing a special clock and spring motor for actuating an approved knife switch, 2 or 3 pole, 30-A., 250-V. Approved September 18, 1907. Manufactured by

Clark & Harvey, Dayton, Ohio.

CABINETS.

G. E. cast-iron boxes with combination plug fuse cut-outs and lever switches for service entrance work. Cat. Nos. 45,008-45,017, inclusive. Approved Oct. 1, 1907. Manufactured by

General Electric Co., Schenectady, N. Y.

CONDUIT BOXES, FLOOR OUTLET.

F. A. Postoffice Floor and Wall Box. An iron box with floor plate and nozzle or steel face plate for wall outlets. Approved Oct. 7, 1907. Manufactured by

Frank Adam Electric Co., St. Louis, Mo.

RECEPTACLES, STANDARD.

Bryant sign receptacles, Cat. Nos. 1,700 and 46,749. Cleat receptacles, Cat. Nos. 9,402, 9,403, 921, 1,011, 1,123, 50,715, 11,221 and 28,795. Concealed receptacles, Cat. No. 50,744. Conduit box receptacles, Nos. 9,514 and 9,397. Approved October 7, 1907. Manufactured by

The Bryant Electric Co., Bridgeport, Conn.

SWITCHES, COMBINATION CUT-OUT.

D. & W. panel cut-outs with knife switch and plug fuses. Cat. Nos. 25,028 and 25,029, 0-30-A., 125-V. Cat. Nos. 25,030 and 25,031, 0-30-A., 250-V. Approved October 7, 1907. Manufactured by

D. & W. Fuse Co., Providence, R. I.

SWITCHES, KNIFE.

Cuthbert panelboard switch, 15-A., 125-V. Approved October 4, 1907. Manufactured by

Cuthbert Electrical Mfg. Co., Chicago, Ill.

SWITCHES, SURFACE SNAP.

G. E. Cat. Nos. 34,264, 39,134, 34,444, 39,135, 34,443 and 34,445. Indicating and non-indicating surface-snap switches, 2,508, 34,264 and 39,134, single-pole, 3-A; 34,444 and 39,135, double-pole, 10-A.; 34,413 and 34,445, three-way, 3 and 5-A., respectively. Approved September 19, 1907. Manufactured by

General Electric Co., Schenectady, N. Y.

WIRES, RUBBER COVERED.

Marking: One red and one blue thread, running parallel with wire between rubber insulation and the braid. Approved September 30, 1907. Manufactured by the

Consumers' Rubber Co., Bristol, R. I.

Marking: Red thread woven into braid. Red, white or black cores. Approved September 30, 1907. Manufactured by

Home Rubber Co., Trenton, N. J.

SOCKETS, STANDARD.

Bryant, Brass Shell, Key and Keyless, Cat. Nos. 9386, 9392, 50,760, 50,768, 99,386, 99,392, 43,389, 43,390, Fixture Sockets, 1317-1320, inclusive, and "Security Snap," Nos. 44,-147-44,152, inclusive, and 44,814, 44,815. Also above types with shade holders attached. Approved October 1, 1907. Manufactured by

Bryant Electric Company, Bridgeport, Conn.

M. S. Brass Shell, Key and Keyless, Cat. Nos. 9386, 9392, 50,760, 50,768. Also above types with shade holders attached. Approved October 1, 1907. Manufactured by

Marshall Electric Mfg. Co., Boston, Mass.

Perkins Brass Shell, Key and Keyless, Cat. Nos. 9386 P, 9392 P, 50,760 P, 50,768 P. Also above types with shade holders attached. Approved October 1, 1907. Manufactured by

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

Weber Brass Shell, Key and Keyless, Cat. Nos. 372-375, inclusive, 573, 575. Approved October 1, 1907. Manufactured by

Weber Electric Company, Schenectady, N. Y.

G. E. Brass Shell, Key and Keyless Sockets, with or without shade holders, Edison type, key, Cat. Nos. 9386, 1317, 50,760, 1318, 99,386 and electrolier, Cat. Nos. 29,623 and 29,624, keyless, Cat. Nos. 9392, 1319, 50,768, 1320 and 99,392. T. H. types, key, Cat. Nos. 50,713 and 50,761, keyless, Cat. Nos. 50,714 and 50,769. Approved October 22, 1907. Manufactured by

General Electric Company, Schenectady, N. Y.

Hubbell: "Dazzlite" attachment for oil lamps, 50 C. P., 250 V., Cat. Nos. 5403, 5405, 5529, 5530. Approved October 22, 1907. Manufactured by

Harvey Hubbell, Inc., Bridgeport, Conn.

MISCELLANEOUS.

"Hubbell" Shade Holders and Shades, Cat. Nos. 5339, 5340, 5528. Shades, all styles, aluminum, tin and steel, with enameled or polished reflecting surfaces. Approved October 22, 1907. Manufactured by

Harvey Hubbell, Inc., Bridgeport, Conn.

"Standard" Christmas Tree Electric Lighting Outfit, 125 V. Approved pull-off attachment plug, flexible cords, and not more than 36 miniature sockets and lamps per outfit, with porcelain junction block for cords. Approved October 18, 1907. For use only on Christmas trees when properly installed. Manufactured by the

Standard Electric Manufacturing Co., Niles, Ohio.

NOTES ON NAVAL WIRELESS TELEGRAPHY ON THE PACIFIC COAST.

In connection with the recent successful establishment of a naval wireless telegraph station at Sitka, Alaska, new records for long distance transmission in the Pacific were obtained. The flagship West Virginia, shortly after leaving Honolulu for the Pacific Coast, heard North Head, at the mouth of the Columbia River, working with Sitka, distance 1,860 miles. Later Sitka read the army transport Thomas at a distance of 2,200 miles.

It is expected that the chain of wireless stations will be extended to Valdez in Alaska, next summer.

The steamers President and Governor, of the Pacific Coast Steamship Company, in connection with the naval stations between San Francisco and Puget Sound, are able to keep in touch with the world for the whole stretch of their route to the Sound, and for a considerable distance between the Sound and Nome in Alaska. Messages at distances over a thousand miles have been received. North Head receives most of these messages, which are forwarded over the Western Union lines by the Government operators. Communication from the shore to these ships can also be enjoyed through these stations. The Queen, of the same line, on the run to San Diego, is also fitted with wireless.

Sitka station is in cable communication with the world. Tatoosh, North Head, Table Bluff, Farallones (practically), Mare Island, Pt. Arguello, and Pt. Loma are all connected with the wires of the Western Union. It is expected that Cape Blanco will soon have telephone communication. Among these stations Table Bluff is frequently called on to give the City of Eureka telegraphic touch with the world when the land wires are down.

The activity of all the stations has increased with the increase in the number of ships-of-war on the coast, and will increase still more when the battle-fleet has arrived and more commercial vessels have installed wireless apparatus. Quite a number of vessels will shortly be so equipped, adding to the safety of the ships and the comfort of the passengers.

While the ships of the Pacific fleet are at target practice in Magdalena Bay, on the lower California coast, 500 miles from San Diego, not only are the ships in daily communication with the world by means of the wireless station at Pt. Loma, but this station nightly furnishes them a resume of the news of the day by copious extracts from the daily papers.

Great interest will attach to the arrival of the battle-fleet in connection with the wireless telephones with which a number of the ships have been equipped. The guaranteed radius of their working is five miles, though this distance has been exceeded.

Commander H. C. Gearing, equipment officer at Mare Island Navy Yard, under whose administration all the wireless stations along the coast have been established, has received orders from the Navy Department, which send him to Cavite Station, Philippine Islands.

The first Gramme ring dynamo built in the United States was made at Cornell University in 1875, by Professor Wm. A. Anthony and G. S. Moler. It has been in continuous use ever since. Movable rocker arms for the brush holders were first used on this machine. There are two independent sets of windings on the armature, each having its own commutator.

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VOL. XIX NOVEMBER 30, 1907 No. 22

EDITORIAL.

COLLEGE TRAINING AND THE SCIENCE OF ILLUMINATION.

Mr. L. B. Marks, the inventor of the enclosed arc lamp, has recently made a plea to the universities to the end that they offer special instruction in illuminating engineering. His position has been paralleled by those interested in the manufacture and sale of gas. Notwithstanding the great extent of the gas industry and the importance of illumination, there is probably no technical school or college in the country today which makes a specialty of instruction in either field. A few institutions have added to their engineering departments special courses in telephone engineering, but for the most part the course in electrical engineering includes all the work done in the general or special lines in illumination, telephony and similar lines.

The question naturally arises as to how far it is wise for the technical school to go in the training of specialists, or perhaps it might be better expressed as to what extent technical courses should contain material which consists of specific information, data and facts as contrasted with the discussion and elaboration of general principles. The field of the illuminating engineer is such that the question as applied to this particular matter is worthy of considerable investigation. It is quite true that in the past electrical engineering courses have given particular attention to the machinery and distribution lines connected with electric light and power systems, which, of course, includes all kinds of electric traction. General principles have found their application in such courses almost exclusively in the lines above indicated, but it may be true that the same principles which should be the backbone of every university course may find their application in the field of illumination, gas manufacture, telegraphy, or telephone practice.

One difficulty which is likely to arise if university courses become too special, embodying only detail information, is that specialists only of considerable experience will be competent to give such instruction. On the other hand, it must be remembered that the average engineering student is not mature, and his future field of opportunity may be very much restricted if his time in the university is taken up with the acquiring of more or less important information rather than a rigorous training of the mind, as well as the hand, in such work as mathematics, physics, chemistry, drawing, shop and laboratory work.

It is undoubtedly true that technical training many times is of such a character as to practically fail in interesting the student in real engineering problems, and, perhaps, the criticism which is most often heard of the college graduate is that he has an exaggerated opinion of his ability and an entirely inadequate conception of his duties and responsibilities.

Taking it for granted that the course usually found in a good engineering school is composed of the preliminary work in mathematics, physics, chemistry, drawing, elementary surveying and kindred subjects, followed in the last two years by courses in general electrical and mechanical engineering, let us see if the properly trained young man in such an institution could not readily grasp and make a success of the general principles of illumination. Broadly speaking, it has been said that illuminating engineering covers that branch which deals with the production and utilization of light. As a matter of fact, it is only within the past year or two that the engineering side of illumination has received proper recognition. It is, perhaps, surprising that this branch of the engineer's work should have remained so long neglected, but the reason undoubtedly has been that practical electric light and gas men, while conscious perhaps of the wasteful use of light, had other problems crowding them which required immediate attention, and there was constantly before them a multitude of other engineering questions all relating to the production and distribution of the product from which light or illumination is produced.

At the present time many of these problems have been successfully and satisfactorily solved, inasmuch as gas or electricity both are now produced cheaply and transmitted efficiently with proper equipment to the point of consumption.

A study of the engineering of illumination in its broadest aspect must naturally include a study of all illuminants themselves. Foremost among them is, perhaps, the electric light, which is followed closely by gas and oil. Good engineering in the illumin-

ating field must take into account not only the strictly engineering, but the economical and artistic sides as well.

Probably just at the present time we have at hand more important problems in the engineering of illumination than ever before. In the electric lighting field, in addition to the much used open and enclosed arc and the incandescent lamp, the mercury and flaming carbon arc, the so-called metallized incandescent lamps and vacuum tubes all involve investigations not previously encountered in connection with the older type of lighting appliances.

The engineer who has to do with the problems connected with illumination must give proper consideration to the type, size and number of the light units to be used, as well as their location, and finally the character of globes, shades or reflectors, which may be best suited to the required conditions of illumination. In addition, he must be able to suggest whether the desired results will be obtained by the use of general or localized illumination, or both. Again, satisfactory results will depend many times upon whether the lighting is to be direct or indirect, that is, whether the illumination is to come from the source of light without reflection or to be augmented or supplemented by reflectors, either artificial or natural, such as the walls or ceilings of the room illuminated. Again, the color of the light may be a most important factor, and it is perhaps in this connection, more than any other, that the measurement of light by the unit known as the candlepower is most unsatisfactory.

These are some of the fundamental questions involved in illuminating engineering. The question then naturally arises as to whether it is better for such matters to be considered in a strictly technical university course, or should the time given to university instruction, which is none too long, even under the best conditions, be exclusively used for the discussion of broad general principles, the mastery of which should make it possible for the student upon entering practical work to readily apply his knowledge to the solution of special practical problems.

The technical school is in part a place for research work, and in part a school of general instruction, and it must be borne in mind that the university graduate, far from being an engineer, upon completing his college course, is very fortunate indeed if he has received the training of mind and general foundation which will make it possible for him to become an engineer when he has supplemented his university work with actual experience. It may be well enough for the engineering departments of our leading universities to give their students an insight into the problems of illumination, but it is doubtful if the time could not be better spent in scientific lecture and laboratory courses in general physics, which must of course have direct practical application to the problems in hand.

In general, that technical institution has been the greatest success as an institution of learning which minimizes the presentation of engineering details to its students and lays the most important stress upon the mastery of mathematical and scientific principles, the application of which is directly pointed out in the lecture and laboratory courses.

BENJAMIN WIRELESS CLUSTER PATENT SUSTAINED.

Friday, November 15, 1907, the Circuit Court of Appeals for the Second Circuit (Judges Lacombe, Coxe and Ward), rendered a decision sustaining claims five and seven of the Benjamin Wireless Cluster Patent Nos. 721,774, dated March 3, 1903. The suit was that of the Benjamin Electric Manufacturing Company against the Dale Company and John H. Dale, and involved the Dale Multiple Wireless Cluster, which was first placed upon the market by the Dale Company in the Spring of 1904. The case originally came before Judge Holt of the Circuit Court, and he sustained the validity of the Benjamin patent, but he held that the Dale Cluster did not infringe. The Court of Appeals, while confirming Judge Holt as to his finding of validity, reverses the lower Court on the question of infringement, and finds that the Benjamin patent as to claims five and seven is infringed by the Dale Wireless Cluster. A second suit brought by the Benjamin Electric Manufacturing Company against the Dale Company and John H. Dale, concerns the series Wireless Cluster marketed by the Dale Company. An order has heretofore been entered in this second suit providing for an injunction and accounting as to the Dale Series Cluster in case the Court entered an injunction and an accounting as to the Multiple Cluster involved in the first suit.

The litigation has been closely contested by both sides, and has occupied the attention of the courts during the past three years. Complainant was represented by the firm of Jones, Addington & Ames (Wm. H. Kenyon and W. Clyde Jones of Counsel), and the defendant by Rosenbaum & Stockbridge.

PERSONAL.

Robert Sherman has resigned as superintendent of the Los Angeles Pacific Railway.

The F. J. Sprung Co., inspectors and repairers of motors, are now at 1277 Mission Street.

Platts & Ware, electricians, have moved from 1277 Mission Street to 1608 Jones Street, San Francisco.

A. C. Thode & Co. have the contract for the electrical equipment of the Albany Brewery at 8th and Harrison Streets.

R. H. Stirling has been appointed general manager of the American River Electric Company, with headquarters in Stockton.

Rev. R. M. Sherman will deliver the address at the Founders' day exercises of Thomas S. Clarkson Memorial School of Technology on November 30th.

L. H. Taylor, who has had charge of reclamation work in California, and at the head of geodetic surveys in Nevada, has taken a position as supervising engineer with the California-Nevada Power Co.

Robert Sibley has resigned as Professor of Electrical and Mechanical Engineering at the University of Montana, to engage in engineering consulting practice at Missoula, Montana. He is a graduate of the University of California.

R. D. Tomlinson, of Milwaukee, Wis., supervising operating engineer of Allis-Chalmers Co., recently addressed the Toledo section of the American Institute of Electrical Engineers, on "Power Station Design, Construction and Operation."

CURRENT COMMENT

Glass brushes are being made to replace emery cloth for cleaning and polishing the commutators of dynamos and motors. They not only avoid the dangers and inconveniences of emery cloth, but also clean without scoring the metal.

The Japanese and Russian governments are erecting a series of radio-telegraph posts throughout Siberia, so as to afford communication between the two countries by this means. It appears that the project is to be ratified at the next congress of radio-telegraphy.

With gold leading the list with a production of $18,732,452, the total mineral output of California during 1906, according to returns received at the State Mining Bureau, reached $46,776,085. This is an increase over the previous year of $3,706,858. The most notable increases were in copper, gems, tungsten and asphalt. For the first time zinc appears among the mineral products of the State, but the value of the output was very small, $12,566. Petroleum came next to gold in total value, being produced to the extent of $9,238,020. Copper is third in the list, amounting for the year to $5,522,712. Clays and their products, cement, borax and silver follow in the order named. Of brick there were produced $2,538,848 worth, and the value of the clay used for pottery was $162,283. The production of cement amounted to $1,941,250; borax, $1,182,410; silver, $817,830. The total value of the non-metallic mineral substances was $2,589,984, an increase of $444,054 over 1905.

French interests in the Western Soudan have grown until the telephone has become a necessity. Hundreds of natives are now stringing telephone wire to the Niger and down that river to Timbuctoo. The first enterprise was to connect the leading business centers of the interior; and these connections have now been made between Kayes, the head of navigation on the Senegal, and Medine, further up that river; between Kita and Bammako on the Niger, more than 100 miles, and down the Niger to the Kalikoro region fifty miles. The wires are now to be strung to the terrace overlooking the Sahara on which the famous city of Timbuctoo stands. Twenty-seven years ago Dr. Otto Lenz entered Timbuctoo in the guise of a learned Mohammedan doctor and traveler. He was the last of five white men who in the course of 250 years saw this most fanatical of the cities of Islam. Of these five men one was enslaved and died in bondage, another was murdered, and three passed unscathed through all the dangers that beset them. It now takes only nineteen days to travel between Paris and the once forbidden city, and life is as safe there as in most cities of the world.

In the testing laboratory supported by the German government any German manufacturer or user of material can have systematic testing work carried out for commercial purposes, in an impartial manner, and at reasonable charges. Inventors and manufacturers who desire complete and careful research into new ideas and processes can, if there is a reasonable prospect of the investigation leading to the development of an industry, have the full assistance of the resources of the establishment and the advantage of trained testers to help them. In addition to this outside work, investigations are carried on by the staff of the establishment and these results are published periodically.

The latest idea in storage battery manufacture is embodied in a patent just issued to Homer E. R. Little of New York, who employs two sets of carbon electrodes, one immersed in carbon tetrachloride, over which is placed a solution of zinc bromide, in which is placed the other electrode. When the cell is charged, the zinc from the zinc bromide is deposited in the upper electrode and the bromine is taken in solution by the carbon tetrachloride, and when the cell is discharged the zinc deposited on the upper electrode again combines with the bromide.

Pending the report of its engineers on the electrification of its lines across the Sierra Mountains, the Southern Pacific has added 700 feet to each of twenty-four sidings between Roseville and Truckee, so that trains of forty-five instead of thirty cars can be sent across the mountains to Ogden. One-half the sidings are in the forty-six miles of snowsheds which enclose the road between the Blue Canyon and Truckee. The extension of the snowsheds alone required 7,000,000 feet of lumber. At Summit an entirely new track, 3100 feet in length, was put in to avoid the congestion which has blocked traffic at this point. In addition to the siding extension, the Southern Pacific is laying a double track between Truckee and Winsted and between Elvas and Loomis. This work is almost completed, and with the vast terminal improvements being carried out at Roseville, will double the capacity of the Harriman lines in this territory. In the new Roseville classification yard, the natural distributing points for transcontinental coastwise and transcontinental traffic, the last of fifty miles of track is being laid. The receiving, classification and departure tracks comprise twenty-seven miles, the remainder being storage, repairs and industry spurs. Work is also being rapidly pushed on additional round-house facilities and repair shops at Roseville.

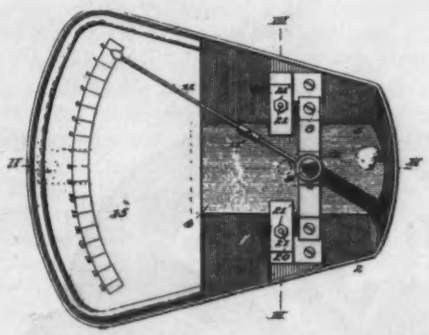
The production of platinum in the United States in 1904 was 200 ounces, valued at $4160; in 1905 the production was 318 ounces, valued at $5320; in 1906 the platinum production of the country amounted to 1439 ounces, valued at $45,189, a forefold increase in quantity and more than eightfold increase in value over the figures for 1905. The principal feature of interest in the platinum industry during the year was the phenomenal rise in prices for ingot platinum, which, beginning with $20.50 per troy ounce on January 6, 1906, had on November 17th reached $38, remaining at this figure until the end of the year, after which there was another slight rise in price. In February, 1907, for the first time, a distinction was made between ordinary platinum and hard platinum, that is, platinum rich in iridium and osmium, considerable iridium being allowed to remain alloyed in the platinum of the ingots. Such hard platinum was quoted at $41 per ounce on February 23rd, and this price held until April 6, 1907, when the placing on the market of more than 100 pounds of platinum by a new producer interested in American developments checked the advance, and on May 4, 1907, ordinary platinum was quoted at $32 and hard platinum at $35. Then a gradual decline set in, and the present price (November, 1907) is $23 for ordinary and $25 for hard platinum.

PATENTS

Electric, Gas and Water.
Specially reported for the Journal of Electricity, Power and Gas.

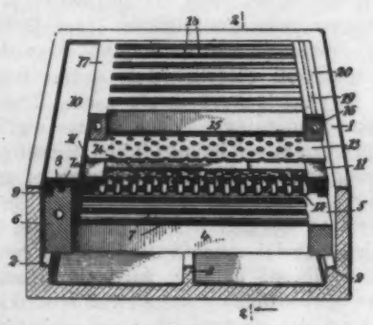
ELECTRICAL MEASURING INSTRUMENT. 870,803. Charles B. Thwing, Philadelphia, Pa.

In a movable coil galvanometer, a permanent magnet, and a coil movable in the magnetic field of magnet, and means responding to changes of temperature for automatically varying the reluctance of the magnetic circuit to compensate for variations in the resistance of the electric circuit of coil due to changes of temperature in the atmosphere surrounding the galvanometer.



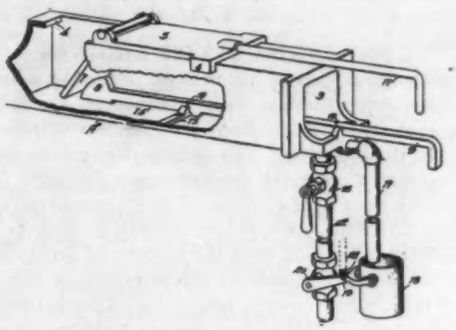
STORAGE BATTERY. 870,973. Homer E. R. Little, New York, N. Y.

The combination of a cell, carbon electrodes therein, carbon tetra-chlorid in the bottom of the cell in contact with one of said electrodes, a solution of zinc bromid superposed on the carbon tetra-chlorid in contact with the other electrode, and means interposed between the electrodes for mechanically assisting in the separation of the two liquids, whereby when the cell is charged, the zinc from the zinc bromid is deposited on the upper electrode and the bromin from the zinc bromin is taken in solution by the carbon tetra-chlorid, and when the cell is discharged, the zinc deposited on the upper electrode combines with the bromin taken in solution to again form zinc bromid.



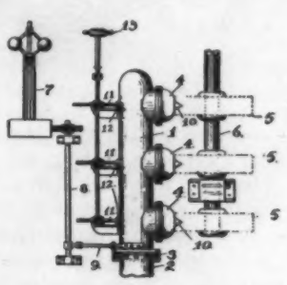
OIL-BURNER. 870,933. Charles C. Cleveland, San Francisco, Cal.

An oil burner having in combination a box-like structure, open at the top and at one end, a movable cover-plate for the open top of the box, a movable damper-plate carried by the cover-plate and regulating the air-draft, damper-plate having its lower end terminating short of the bottom of the box, and an oil-pipe delivering into the box at a point between the open end thereof, and the damper-plate.



REGULATING MEANS FOR IMPACT-STREAMS. 870,292. George J. Henry, Jr., San Francisco, Cal., assignor of one-half to The Pelton Water Wheel Company, San Francisco, Cal.

The combination with a water wheel or hydraulic motor, of a main line water supply pipe, of a straight longitudinal member rotatably connected therewith and constituting a prolongation thereof for directing the impact stream onto the water wheel, an outlet opening in rotatable member, of mechanism for rotating member about its own longitudinal axis for directing an impact stream onto or off the water wheel, and means for controlling the discharge area of the outlet of the rotatable member to regulate the quantity of the water discharge therefrom.



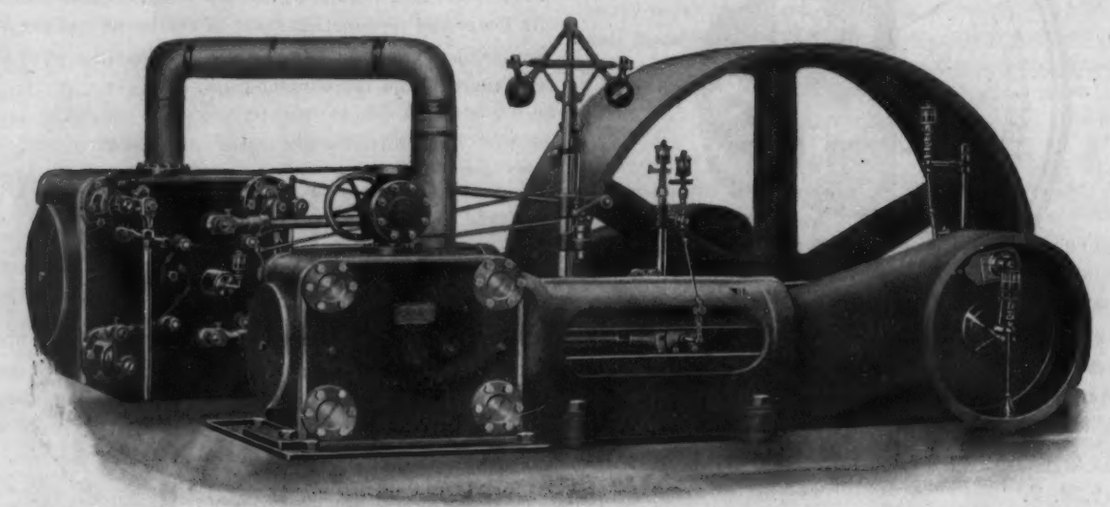
COMPOSITION OR CONCRETE POST. 865,179. Harvey G. Hays and Joseph W. Hays, Chicago, Ill.

In a composition or concrete post, the combination of an inner core of coarse substances, cemented together by a binding substance; a thin outer shell of plastic and homogeneous composition; a meshed reinforcing element, disposed between inner core and outer shell—reinforcing element immediately enveloping inner core and running longitudinally therewith.

INDUSTRIAL

COMPOUND CORLISS ENGINES.

Allis-Chalmers Co., of Milwaukee, is issuing a bulletin on "Compound Corliss Engines," which contains, besides illustrations of each type, many facts of interest to power users throughout the country. "So far as we are aware," it is stated, "the first Compound Corliss engine designed for power purposes was built in the shops of this company, and to our Mr. Edwin Reynolds, who, for nearly half a century, has been so prominently identified with the history of this type, should be given credit for introducing the principle of compounding into general Corliss engine practice. The earliest Corliss engine was built in 1848, and twenty-eight years later the famous "Centennial" engine, which was supposed to embody



in its design and construction the very highest development of the engine builder's art, was nothing more than a pair of simple engines. The first Reynolds-Corliss engine, built in 1877, marked the beginning of an epoch in the history of the steam engine. The first compound Reynolds-Corliss was built three years later, and is still in regular operation."

Since then thousands of these engines have been put in service in electric railway and lighting power houses; in large and small pumping stations; in blast furnaces and rolling mills; in textile mills, flour mills, and sawmills; in foundries, machine shops and woodworking factories; in newspaper and printing establishments; in office buildings; in technical schools and colleges; in all kinds of industrial plants at home, and in nearly every country in the world, Reynolds-Corliss engines have thoroughly demonstrated their good qualities, and its compound engines have contributed largely to the high reputation in which the products of Allis-Chalmers Company are held.

The strong argument in favor of the use of compound engines is their greater economy. The economy of the power plant as a whole is, of course, dependent upon the efficiency of boilers, furnaces, stack, etc., as well as upon engine economy; but, assuming the same efficiency of the other parts of the power plant, the economy of the engine will determine the relative amount of fuel required. Under the same operating conditions, a compound non-condensing, as compared with simple Corliss engine, will effect a saving of at least 20 per cent, and a compound condensing Corliss will effect a saving of at least 40 per cent in cost of fuel. There are few locations where the cost of fuel is so low that such saving will not, after paying good interest on the additional cost of the compound engine, afford a sufficient surplus to wipe out this difference in cost in a very few years.

The importance of this is not confined to the larger plants, for, although the comparative difference in cost may be somewhat greater in the smaller plants, the saving is still large in comparison.

There is a general, though decidedly erroneous, impression among steam users that no great advantages can be gained by compounding unless high steam pressures are used. While it is true that high pressures are conducive to economy in steam consumption, it is equally true that at lower pressures the percentage of saving by compounding is relatively very nearly as great, when engines are run condensing, as at higher pressures. It is true that a compound Corliss will be more economical at 150 pounds than at 100 pounds initial pressure, and it is also true that a compound condensing Corliss, when operating under 100 pounds initial pressure, will use 40 per cent less steam than a simple non-condensing engine under the same pressure. In fact, the great economy of compound Corliss engines was demonstrated, and their reputation established at a time when pressures higher than 80 pounds were rarely used. The economy of compound non-condensing engines is less marked at lower pressures, but even at 100 pounds initial pressure a compound non-condensing engine will effect a saving of approximately 15 per cent.

To determine whether it is better to use a compound engine requires careful consideration of the commercial and engineering conditions in each particular case. The compound engine is unavoidably more expensive than the simple engine, against which must be offset the saving in cost of fuel and also in cost of boiler room equipment, owing to the smaller steam-making capacity necessary. The price of fuel and steadiness of operation of the plant have an important bearing in this connection, for, if fuel is inexpensive, or if the engine is to run only a few hours per day or for a short period each year, the annual saving may not warrant the additional cost of the plant. On the other hand, if the engine is to be run steadily the annual saving, even with low-priced fuel, will more than warrant the additional investment. The per-

manency of the plant is also a factor in the problem.

Whether a compound engine, if used, shall be horizontal or vertical, cross or tandem, condensing or non-condensing, must be determined by local conditions. Vertical engines cost more than horizontal engines of the same power, require less floor space and more head room, and are not used, as a rule, except in the largest sizes, or in smaller sizes only where the floor space is limited. Combined horizontal and vertical engines in many cases meet space requirements and operating conditions better than either vertical or horizontal engines. Cross compound engines occupy somewhat less length and greater width of floor space than tandem engines having the same sized cylinders, have a more uniform turning moment, and, especially in the larger machines, are more convenient of access to the lower pressure cylinders and are more easily handled in starting and stopping. Condensing engines require an ample supply of water, of not too high temperature, for condensing the steam; the lower the temperature the less the quantity of injection or circulating water required. In many cases, where the supply of water is limited, it may be cooled in ponds or in cooling towers and used repeatedly. Where no water is available for condensing purposes, or where the exhaust steam can be profitably used for heating or drying, non-condensing compound engines may often be used to good advantage.

Allis-Chalmers Corliss compound engines are built in various types, styles and patterns, of any desired capacity up to 10,000 horsepower (or larger if wanted), and for any required service, from ordinary factory use to the heaviest and most severe electric power and rolling mill work; so that the intending purchaser has a wide field from which to make selections.

To secure the best result in reliability and efficiency, engines should be designed for the work which they are to do, and the conditions under which they are to operate. To this end, and to better enable its engineers to advise and assist customers in their selection, inquiries addressed to the builders of these machines should state:

1. For what service the engine is intended; if for mill or factory, what kind if for an electric plant, whether lighting or power, or both.

2. The minimum, average and maximum horsepower required.

3. Whether any provision must be made to provide for possible future increase.

4. Whether power is to be taken off by belts, ropes, or direct connected to engine shaft. If belt or rope drive, which is preferred. Give speed at which driven pulley on line shaft or machine to be driven must run, and the horizontal and vertical distance between centers of flywheel and driven pulley, and whether belt or ropes will lead forward away from cylinders or back by cylinders.

5. Whether horizontal or vertical, cross or tandem engine is wanted. This may depend upon how the engine is to be located and the available floor space, and it will help to a better understanding of what is required if a sketch is sent showing proposed location and arrangement of engine with relation to line shaft, machinery to be driven, boilers, etc. Sketch should give limiting dimensions, if any.

6. If engine is to be belted or direct connected to electric generator, give voltage and required output in kilowatts at full load, and state whether alternating or direct current will be used. Also state whether machine is to operate in parallel with other units, and if alternating current, state frequency or number of cycles. Should also know the power factor under which generator is to operate. The company builds a full line of electrical machinery and can furnish complete units, with all auxiliary apparatus.

7. Steam pressure at engine throttle valve.

8. Whether condensing or non-condensing engine is wanted. If condensing, state vacuum in inches of mercury (referred to 30" barometer). If non-condensing, state whether engine will exhaust freely to atmospheres or against what back pressure it must operate.

9. What quantity of water for condensing purposes is available, and at what temperature. Also give level of source of supply below or above floor of engine room. Condensing apparatus should be especially designed to meet the purchaser's requirements, and this Allis-Chalmers Company states it is prepared to furnish.

The Northwestern Pacific Railroad Company of San Francisco, a consolidation of the old North Shore and the California Northwestern Railway, now owned by the Southern Pacific system, has recently purchased additional power equipment for installation in the San Anselmo substation of the North Shore Railroad. This equipment comprises two 500-kilowatt Allis-Chalmers two-bearing, motor-generator sets, a 30-kilowatt induction motor generator exciter set, and three 300-kilowatt Allis-Chalmers oil filled water cooled transformers of 54,000 volts. The San Anselmo sub-station will receive 3-phase, 60-cycle alternating current, at 54,000 volts, and furnish direct current at 600 volts and at 1,200 volts by means of Allis-Chalmers synchronous motors driving 600 volt, direct current generators and through a double set of bus-bars. These synchronous motors will have normal rated, full load capacity of 800 brake horsepower.

Monterey, Cal.—The new Station "A" of the Monterey County Gas & Electric Company is fast approaching completion at Monterey, and it is expected that it will be delivering electric power before the Christmas holidays. While not remarkable for its size, the new plant is noteworthy in the thoroughly modern character of its design. Alternating current at 2300 volts, three phase, is generated by two 500 kilowatt Curtis steam turbines direct connected to General Electric generators. One 300 kilowatt and one 125 kilowatt motor generating sets utilize a part of this power for the street railway system, and a 2300 volt feeder and net-work supplies light and power to the cities of Monterey and Pacific Grove and their environs. Steam is furnished by Babcock and Wilcox water-tube boilers with oil furnaces. The new station adjoins the old power house, which will be dismantled as soon as the change-over can be made. Wm. H. P. Hill is general manager of the company, and F. J. Southerland general superintendent.

JAMESTOWN EXPOSITION AWARDS.

James L. Farmer, secretary of the Jury of Awards, Jamestown Exposition, has notified the General Electric Company that it has been awarded two gold medals and a bronze medal on account of its exhibit at the Exposition. The classification by which the jury was governed in granting the awards limited them to one in each department, while previous Expositions have allowed separate awards for each class of material exhibited. The General Electric Company's exhibits are grouped in three departments: The Machinery, the Manufactures and Liberal Arts, and Mining Departments. A collection of motors applied to various machine tools and other devices has been awarded a gold medal. The arc and incandescent lamps and electric cooking applications exhibited in the departments of Manufactures and Liberal Arts are also awarded a gold medal. The company exhibited a special motor designed particularly for use with an Ingersol-Temple Pneumatic Rock Drill, and this motor, because of its peculiar adaptation to the special service was awarded a bronze medal. The company was also awarded a silver medal for installation of exhibit.

NEWS NOTES

TRANSPORTATION.

Red Bluff.—The electric railroad franchise ordinance has been passed as applied for by F. S. Granger.

Hayward.—Bids will be received by the Trustees up to December 4th for the franchise applied for by the Oakland Traction Company.

El Paso, Tex.—The turbo-generator at the plant of the El Paso Electric Railway was damaged to the extent of $4,000 to $5,000. It will be replaced as soon as possible.

San Francisco.—The Ocean Shore Railroad Company has commenced operation of a daily train over its new road-bed from Twelfth and Mission Streets to Pedro Valley, twenty miles south of San Francisco. For the present but one train a day will be operated.

East Las Vegas, N. M.—The first long-distance electric road in New Mexico has been decided upon, and location will be started next week. W. A. Buddocke of Las Vegas promoted the enterprise, and $80,000 of the $100,000 necessary has been raised. The line will be the Las Vegas-Mora-Taos Electric Railroad.

Vallejo.—People interested in the Lake & Sonoma County Railroad, which proposes to build a line from Lakeport to Hopland, on the line of the California Northwestern, have received word from Colonel J. F. Fulton, the promoter of the road, that a satisfactory traffic arrangement has been made with the California Northwestern and that every indication points to construction work being started in the spring. The company recently paid the full price of its terminal property under bond in Lakeport and in Hopland and other towns.

San Francisco.—President Horace Platt, of the Geary Street Railroad, has petitioned the Supervisors to reduce the percentage of gross receipts required to be paid the city by the road from ten to three per cent. Mr. Platt reminded the Board of a promise made when the rate was raised from five per cent, that if the charge proved confiscatory it would be withdrawn. Mr. Platt asserted that whereas the receipts in May for this year were $24,806, in October they were $17,112. In April the profits of the road, he said, were $6,430. Last month he claimed a loss of $7,694.

Los Angeles.—Assurances have been received that when the Board of Public Works advertises for bids for hauling material for the aqueduct, the Southern Pacific will put in a bid for work to a point seventy-five miles north of Mojave. This is taken to mean that the Southern Pacific Company will build a road at least that far, and certainly the line would be extended the full length of the aqueduct route. It will be some time before this line is actually needed. This would mean another transcontinental cut-off over an easy grade by way of Carson City and connection with the old Central Pacific. The road in the Owens River Valley is to be used for hauling material for the aqueduct. As a result of the recent conferences with railroad officials the Aqueduct Commission feels confident that a favorable decision will be reached.

WATERWORKS.

Santa Cruz.—The Superintendent of Water Works has been ordered by the Council to provide fire hydrants to replace the old ones on Pacific Avenue. The Fire Committee was authorized to ask for bids on 2000 feet of new hose.

Calexico.—F. C. Paulin, one of the owners of the Calexico townsite and local waterworks, was in Calexico this week to confer with local men regarding the water supply. He states it is the intention to put in a good water system.

Vallejo.—To meet the increased demands of the Mare Island Navy Yard and Vallejo upon the municipal water system, the city is planning to spend $50,000 to build a second reservoir in Grenn Valley for the storage of double the amount of water now used. The Government pays the city of Vallejo about $20,000 annually for water.

Honolulu, H. I.—At the last meeting of the Alewa Improvement Club, plans were reported for installing a 5000-gallon tank at the end of the water main at the Alewa quarry and a 10,000-gallon tank at the highest point on the Alewa lots, the water to be raised by means of a gasoline pump. The expense will be met through either a stock company or a partnership.

Ocean Side, Cal.—The City Trustees have opened bids for a pumping plant from the Pacific Coast Manufacturing Company, S. S. Smith Machinery Company and Baker Iron Works. The bid of the Pacific Coast Manufacturing Company appeared to be the most satisfactory, though $3,000 higher, as it provided for a plant which provided a good margin over specified capacity.

Sacramento.—Among the warrants drawn by State Controller Nye was one for $1,327 for the city of Los Angeles. This represents installments paid to the State for lands presumed to be owned by California, but later ascertained to be private property. Los Angeles was desirous of securing all the unbought State school lands in the Independence district of the Owens River country and using them for certain purposes connected with the Owens River water system project. Agents of the city staked out the lands wanted and paid the State the first installments on the total price of the purchase. Investigation disclosed the fact that several thousand acres upon which installments had been paid were not at the present time State school lands, and so Controller Nye paid back to Los Angeles the difference.

ILLUMINATION.

Gilroy.—The City Council has decided that considerable money must be spent for new machinery at the gas works.

Oroville.—The Oro Water, Light & Power Company has a crew of men at work in Humbug Valley digging a big ditch to convey water to a point on Feather River, where, within the course of a couple of years, a plant will have been installed.

Reno, Nev.—George Askerman, who has a contract and franchise at the present time to build a gas plant in Portland, Ore., at a cost of more than $1,500,000, is spending a few days in Reno, and states that it is possible he will build a large plant here.

Hermosa, Cal.—At a meeting of the Board of Trustees, the proposition for an electric light plant came up. A communication from S. J. Smith Machinery Company stated that it would be pleased to bid on the plant. The Standard Electric Company sent a similar communication. Fifteen thousand dollars is estimated as the cost of the plant.

Oakland.—The Oakland Gas Light & Heat Company has been issued a permit for the erection of a steel gas storage tank to cost $162,000. The work is to be done by R. D. Wood & Co., of Philadelphia. The tank, which is to go up on a foundation already built near the Market Street gas plant of the company, will have a capacity of 2,000,000 cubic feet of gas.

San Diego.—The Consolidated Gas & Electric Company has cut rates on its electric current and proposes to double the capacity of the plant, the work of which will be carried out at once. Some of the additional equipment and machinery is already en route. The capacity of the gas plant is also to be increased, and orders for additional equipment are to be placed in a short time. During the present month a 530 horse-power boiler will be added.

Alameda.—The Electricity Commission has let the contract to Couchot & Thurston for the reinforced concrete building which is to house the electric light plant. The contract price is $25,495. There was but $5 difference between the lowest bidder and that of Powell Bros., the latter firm bidding $25,500. The new unit, to cost $30,900, has been ordered, and will be installed about January 1st.

Fresno.—The Fresno Home Light & Power Company has had a mechanical engineer going over the ground here. At the meeting of directors and stockholders last week he presented reports of an encouraging character regarding the future operations of this company. The first report on the estimated cost of installing the light and power plant agreed with the original estimate on which the incorporation was decided upon. The directors favorably considered an enlargement of the scope of operation of the company. This is a proposition to lay a pipe line from Coalinga to convey oil to Fresno for sale to general consumers. The pipe line would be forty-five miles long, using four or four and one-half inch pipe, and the cost of installing the line would be approximately $80,000. The company proposes to use crude oil as its fuel for the operation of its light and power plant.

FINANCIAL.

Madera.—The Trustees have decided to call a bond election for sewers and waterworks.

Gallup, N. M.—The people of Gallup have voted bonds for $20,000 for obtaining a modern water supply.

Bakersfield.—The following oil companies have declared extra dividends: Peerless, 5 cents; Union, $1; United Petroleum, 85 cents.

Bakersfield.—The Washington-Kern Oil Company has levied an assessment of 1 cent per share, delinquent November 20th, sale day December 7th.

Red Bluff.—An assessment of 7 cents per share, delinquent November 20th, sale day December 7th, has been levied by the Pacific Power Company.

Willows.—The report sent out from Willows that the Northern California Power Company had bought out the Willows Water & Light Company is positively denied by the latter corporation.

San Francisco.—The Spring Valley Water case, now pending before the United States Circuit Court, came up on the law and motion calendar last week and went over for the term and will not be heard until March.

Pasadena.—In the matter of the contemplated purchase of the water systems of Pasadena companies for a municipal system, it has been decided by the city officials that a bond election will have to be called, submitting the question of paying for the extra improvements which have been made by the different companies. This will involve an outlay of $180,000 in addition to the $900,000 already voted by the people. It is not intended to delay the bond issue on the sewer and fire matters until the water question is settled.

INCORPORATIONS.

Reno, Nev.—Articles of incorporation of the Lower Truckee Electric Company have been filed, and another power plant launched in Nevada. The primary purpose of the corporation will be to supply the mines of Fairview, Wonder and Olinghouse with power and light, and the company will probably run a line into Reno and the Carson Valley to compete with the Nevada Power, Light & Water Company, and the Truckee River General Electric Company. The new corporation has been at work along the Truckee River in the neighborhood of Logarmarsino's ranch, a few miles east of Reno, where it is planning to place a large dam across the river. The river has a large fall at this spot. Surveys and plans for the construction of the plant are completed. The capital stock is placed at $50,000. The incorporators are: T. W. Haines, of Oakland; W. H. Hall, of Gridley, Cal., and Henry W. Esden of Reno.

WATERWORKS.

San Francisco.—City Engineer Woodward has formally filed with the Supervisors' Fire Committee a copy of the plans and estimates for the proposed auxiliary fire protection system.

Manila, P. I.—Sealed bids or proposals will be received up to January 15th, for furnishing and installing electrically driven pumps and motors for the new sewer system in the city of Manila. There will be one main station and five sub-stations, each equipped with two pumps and corresponding motors, or a total of twelve pumps and motors. All the work will be let as one contract.

TELEPHONES.

Waitsburg, Wash.—B. A. Pranger was given the privilege of constructing a telephone line along certain county roads.

Kalama, Wash.—The Northwestern Long Distance Telephone Company is installing its line between Kalama and Vancouver.

Davenport, Wash.—Telephone franchise granted to the Larena Farmers' High Line Telephone Company over certain roads in Lincoln County.

Touchet, Wash.—E. C. Burlingame states that he will at once erect a telephone line from Gardena to Touchet. The poles for it have already been delivered at the former place.

Pasco, Wash.—The telephone franchise created by ordinance No. 57, and granted to Chas. A. Newton last Spring by the City Council, was assigned to the Twin City Telephone Company.

Stevensville, Mont.—This week work was finished on the new rural telephone system of the Burnt Fork Telephone Company, and thirty-six instruments are now in use. The wires of the system cover about thirty-six miles.

Missoula, Mont.—The Bitter Root Telephone Company has been organized with C. M. Allen as president; T. A. McClain, as secretary, and Sam McClay, as treasurer. The new company will construct a telephone line from Lolo to Carlton, connecting with about twenty ranches in that section.

Cheney, Wash.—W. T. DuBoise, who was to have his telephone service in operation by November 9th, has had his time extended by the Council until the 15th, because of the fact that the Washington Water Power Company are setting poles along the different streets and disturb the telephone wires to such an extent that permanent work can not be done until they have finished.

Hamilton, Mont.—The stockholders of the Bitter Root Telephone Company, which owns the small lines connecting Hamilton, Woodside and other west-side points, held a meeting Monday evening, at which it was decided to immediately begin the extension of the lines with a view to covering ultimately the entire valley and placing a phone in every farm house. It is a co-operative company, and it is proposed to furnish telephone service at the lowest cost consistent with successful operation.

Dillon, Mont.—The stockholders of the Southern Montana Telephone Company held a business meeting at the office of F. A. Hazelbaker in the Court-house last week and elected officers for the ensuing year. Those elected were: Leonard Eliel, president; A. L. Stone, vice-president; F. A. Hazelbaker, secretary and treasurer and general manager of the company. The Board of Directors selected consists of B. F. White, A. L. Stone, F. A. Hazelbaker, Leonard Eliel, Wm. Knapp, Edwin Norris, and W. A. Jones, all of Dillon; C. H. Strowbridge, of Wisdom, and E. Andrus, of Fox.

CLASSIFIED LIST OF ADVERTISERS

Air Compressors
Hunt, Mirk & Co.

Alternators
California Electrical Works

Aluminum Electrical Conductors
Pierson Roeding & Co.

Annunciators
Electric Appliance Co.
California Electrical Works.
Century-Klein Electric Co.
Holtzer-Cabot Elec. Co.
Partrick, Carter & Wilkins Co.
Tel. and Elec. Equipment Co.

Asbestos Products
Johns-Manville Co., H. W.

Batteries, Primary
California Electrical Works

Batteries, Storage
Western Electric Co.
Century-Klein Electric Co.
Electric Storage Battery Co.
Tel. and Elec. Equipment Co.

Boilers
Moore, C. C. & Co., Inc.
Tracy Engineering Co.
Hunt, Mirk & Co.

Boiler Compounds
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Buffers
Northern Electrical Mfg. Co.

Building Material
Johns-Manville Co., H. W.

Building Paper
Johns-Manville Co., H. W.

Circuit Breakers
Fort Wayne Electric Works
Electric Appliance Co.
Century-Klein Electric Co.

Condensers
O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.
C. H. Wheeler Mfg. Co.

Conduits
American Circular Loom Co.
Electric Appliance Co.
Tel. and Elec. Equipment Co.
Century-Klein Electric Co.

Conduit Fixtures
Century-Klein Electric Co.
Electric Appliance Co.
Tel. and Elec. Equipment Co.

Cooling Towers
O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.
Tracy Engineering Co.

Cross Arms
Century-Klein Electric Co.
Electric Appliance Co.
Tel. and Elec. Equipment Co.
California Pole & Piling Co.

Dynamos and Motors
Brooks-Follis Elec. Corp.
California Electrical Works
Crocker-Wheeler Co.
Electric Appliance Co.
Century-Klein Electric Co.
Fort Wayne Electric Works
General Electric Co.
Holtzer-Cabot Elec. Co.
Northern Elec. Mfg. Co.
Tel. and Elec. Equipment Co.
Westinghouse Elec. & Mfg. Co
Wagner Elec. Mfg. Co.

Elevators
Van Emon Elevator Co.

Electric Car Heaters
Johns-Manville Co., H. W.
Northern Electrical Mfg. Co.

Electric Grinders
California Electrical Works
Northern Electrical Mfg. Co.
Tel. and Elec. Equipment Co.

Electric Heating Devices
Electric Appliance Co.
Johns-Manville Co., H. W.

Electrical Instruments
Electric Appliance Co.
Cutter Co., The
Century-Klein Electric Co.
Fort Wayne Electric Works
General Electric Co.
Johns-Manville Co., H. W.
Tel. and Elec. Equipment Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.

Electrical Machinery
Crocker-Wheeler Co.
California Electrical Works
Electric Appliance Co.
Northern Electrical Mfg. Co.
Century-Klein Electric Co.

Electric Polishers
Northern Electric Mfg. Co.

Electric Railway Appliances
Pierson, Roeding & Co.
Johns-Manville Co., H. W.

Electrical Supplies
California Electrical Works
Century-Klein Electric Co.
Electric Appliance Co.
Johns-Manville Co., H. W.
Tel. and Elec. Equipment Co.

Electric Ventilating Fans
Century-Klein Electric Co.
California Electrical Works
Northern Electrical Mfg. Co.

Engines, Boilers, Heaters, etc.
Moore, Chas. C. Co., Inc.

Electric Watchman's Clocks
Tel. and Elec. Equipment Co.

Engineers, Chemical
Smith, Emery & Co.
Moore & Co., Chas. C., Inc.
Tracy Engineering Co.
Westinghouse Machine Co.
Hunt, Mirk & Co.

Engines, Gas and Gasoline
Moore & Co., Chas. C., Inc.
Westinghouse Machine Co.
Hunt, Mirk & Co.

Engineers and Contractors
Brooks-Follis Elec. Corporat'n
Byllesby & Co., H. M.
California Electrical Works
Cannon, Edward F.
Hunt, Mirk & Co.
Century-Klein Co.
Copeland, Clem A.
Cory, C. L.
General Electric Co.
Hunt, Dillman, Meredith & Allen
Jackson, D. C. & W. M.
Smith, Emery & Co.